```
======================================================================== Linear
                                                                         Linear
     PROGRAM LINEAR                                                      Linear
     ==============                                                      Linear
     VERSION 74-1 (MAY 1974)                                             Linear
     VERSION 75-1 (APRIL 1975)                                           Linear
     VERSION 76-2 (OCTOBER 1976)                                         Linear
     VERSION 77-1 (JANUARY 1977)                                         Linear
     VERSION 78-1 (JULY 1978)                                            Linear
     VERSION 79-1 (JULY 1979) CDC-7600 AND CRAY-1 VERSION.               Linear
     VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION.                  Linear
     VERSION 80-2 (DECEMBER 1980)                                        Linear
     VERSION 81-1 (MARCH 1981)                                           Linear
     VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY.        Linear
     VERSION 83-1 (JANUARY 1983) *MAJOR RE-DESIGN.                       Linear
                                 *PAGE SIZE INCREASED - 1002 TO 3006.    Linear
                                 *ELIMINATED COMPUTER DEPENDENT CODING.  Linear
                                 *NEW, MORE COMPATIBLE I/O UNIT NUMBER.  Linear
                                 *ADDED OPTION TO KEEP ALL ORIGINAL      Linear
                                  ENERGY POINTS FROM EVALUATION.         Linear
                                 *ADDED STANDARD ALLOWABLE ERROR OPTION  Linear
                                  (CURRENTLY 0.1 PER-CENT).              Linear
     VERSION 83-2 (OCTOBER 1983) IMPROVED BASED ON USER COMMENTS.        Linear
     VERSION 84-1 (APRIL 1984)   IMPROVED BASED ON USER COMMENTS.        Linear
     VERSION 84-2 (JUNE 1984)   *UPDATED FOR ENDF/B-VI FORMATS.          Linear
                                *SPECIAL I/O ROUTINES TO GUARANTEE       Linear
                                 ACCURACY OF ENERGY.                     Linear
                                *DOUBLE PRECISION TREATMENT OF ENERGY    Linear
                                 (REQUIRED FOR NARROW RESONANCES).       Linear
     VERSION 85-1 (AUGUST 1985) *FORTRAN-77/H VERSION                    Linear
     VERSION 86-1 (JANUARY 1986)*ENDF/B-VI FORMAT                        Linear
     VERSION 87-1 (JANUARY 1987)*DOUBLE PRECISION TREATMENT OF CROSS     Linear
                                 SECTION                                 Linear
     VERSION 88-1 (JULY 1988)   *OPTION...INTERNALLY DEFINE ALL I/O      Linear
                                 FILE NAMES (SEE, SUBROUTINE FILEIO      Linear
                                 FOR DETAILS).                           Linear
                                *IMPROVED BASED ON USER COMMENTS.        Linear
     VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO      Linear
                                 INSURE PROGRAM WILL NOT DO ANYTHING     Linear
                                 CRAZY.                                  Linear
                                *UPDATED TO USE NEW PROGRAM CONVERT      Linear
                                 KEYWORDS.                               Linear
                                *ADDED LIVERMORE CIVIC COMPILER          Linear
                                 CONVENTIONS.                            Linear
     VERSION 90-1 (JUNE 1990)   *EXTENDED TO LINEARIZE PHOTON            Linear
                                 INTERACTION DATA, MF=23 AND 27          Linear
                                *ADDED FORTRAN SAVE OPTION               Linear
                                *UPDATED BASED ON USER COMMENTS.         Linear
                                *NEW MORE CONSISTENT ENERGY OUTPUT       Linear
                                 ROUTINE.                                Linear
                                *WARNING...INPUT PARAMETER FORMAT        Linear
                                 HAS BEEN CHANGED...SEE DESCRIPTION      Linear
                                 BELOW.                                  Linear
     VERSION 91-1 (JULY 1991)   *ADDED INTERPOLATION LAW 6 - ONLY USED   Linear
                                 FOR CHARGED PARTICLE CROSS SECTIONS     Linear
                                 FOR COULOMB PENETRABILITIES.            Linear
     VERSION 92-1 (JANUARY 1992)*ADDED NU-BAR (TOTAL, DELAYED, PROMPT)   Linear
                                 POLYNOMIAL OR TABULATED ALL CONVERTED   Linear
                                 TO LINEARLY INTERPOLABLE                Linear
                                *INCREASED PAGE SIZE FROM 3006 TO 5010   Linear
                                 POINTS.                                 Linear
                                *ALL ENERGIES INTERNALLY ROUNDED PRIOR   Linear
                                 TO CALCULATIONS.                        Linear
                                *COMPLETELY CONSISTENT I/O AND ROUNDING  Linear
                                 ROUTINES - TO MINIMIZE COMPUTER         Linear
                                 DEPENDENCE.                             Linear
     VERSION 92-2 (JULY 1992)   *CORRECTED CONVERSION OF NU-BAR FROM     Linear
                                 POLYNOMIAL TO TABULATED - COPY          Linear
                                 SPONTANEOUS NU-BAR (BY DEFINITION       Linear
                                 THE SPONTANEOUS NU-BAR IS NOT AN        Linear
                                 ENERGY DEPENDENT QUANTITY).             Linear
```

VERSION 93-1 (MARCH 1993) *UPDATED FOR USE WITH LAHEY COMPILER ON IBM-PCS.
*INCREASED PAGE SIZE FROM 5010 TO 30000 POINTS
VERSION 94-1 (JANUARY 1994)*VARIABLE ENDF/B DATA FILENAMES TO ALLOW ACCESS TO FILE STRUCTURES (WARNING - INPUT PARAMETER FORMAT HAS BEEN CHANGED)
*CLOSE ALL FILES BEFORE TERMINATING (SEE, SUBROUTINE ENDIT)
VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE
*IMPROVED COMPUTER INDEPENDENCE
*ALL DOUBLE PRECISION
*ON SCREEN OUTPUT
*UNIFORM TREATMENT OF ENDF/B I/O
*IMPROVED OUTPUT PRECISION
*DEFINED SCRATCH FILE NAMES
*ALWAYS INCLUDE THERMAL VALUE
*INCREASED PAGE SIZE FROM 30000 TO 60000 POINTS
VERSION 99-1 (MARCH 1999) *CORRECTED CHARACTER TO FLOATING POINT READ FOR MORE DIGITS
*UPDATED TEST FOR ENDF/B FORMAT VERSION BASED ON RECENT FORMAT CHANGE
*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK
VERSION 99-2 (JUNE 1999) *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.
VERS. 2000-1 (FEBRUARY 2000)*ADDED MF = 9 AND 10 LINEARIZATION
*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK
VERS. 2002-1 (MAY 2002) *OPTIONAL INPUT PARAMETERS
VERS. 2004-1 (JAN. 2004) *GENERAL UPDATE BASED ON USER FEEDBACK
VERS. 2005-1 (JAN. 2005) *ALWAYS KEEP ORIGINAL TABULATED NU-BAR POINTS.
VERS. 2006-1 (FEB. 2006) *CORRECTED INT=6 NEAR THRESHOLD
*NO SUBDIVIDE BELOW MINIMUM XCMIN
VERS. 2007-1 (JAN. 2007) *CHECKED AGAINST ALL ENDF/B-VII.
*INCREASED PAGE SIZE FROM 60,000 TO 600,000 POINTS
VERS. 2007-2 (DEC. 2007) *72 CHARACTER FILE NAMES.
VERS. 2010-1 (Apr. 2010) *Skipped leading cross section = 0 up to effective start, unless keeping ALL original energy points.
*Replaced ETHRES by ESTART - it is not a threshold - just a minimum energy - if a section starts above this energy with a positive cross section, an additional point will inserted with cross section = 0.
VERS. 2012-1 (Aug. 2012) *Minor Updates based on User Feedback.
*Added CODENAME
*32 and 64 bit Compatible
*Added ERROR stops.
VERS. 2012-2 (Nov. 2012) *Never thin nu-bar.
VERS. 2013-1 (Nov. 2013) *Extended OUT9.
VERS. 2015-1 (Jan. 2015) *Allow Imaginary Anomolous Scattering Factor to be Negative (MF/MT=27/506).
*Replaced ALL 3 way IF Statements.

OWNED, MAINTAINED AND DISTRIBUTED BY

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AUTHORS MESSAGE

THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION.

AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR COMPUTER.

PURPOSE

THIS PROGRAM IS DESIGNED TO CONVERT ENDF/B FILE 3, 23 AND 27 DATA TO LINEAR-LINEAR INTERPOLABLE FORM. ANY SECTION THAT IS ALREADY LINEAR-LINEAR INTERPOLABLE WILL BE THINNED.

IN THE FOLLOWING DISCUSSION FOR SIMPLICITY THE ENDF/B TERMINOLOGY ---ENDF/B TAPE---WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE TAPE, CARDS, DISK OR ANY OTHER MEDIUM.

ENDF/B FORMAT

THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT).

IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE CORRECTLY OUTPUT ON ALL LINES. THE FORMAT OF SECTION MF=1, MT=451 AND ALL SECTIONS OF MF=3 MUST BE CORRECT. THE PROGRAM COPIES ALL OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE TO THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS.

OUTPUT FORMAT

IN THIS VERSION OF LINEAR ALL ENERGIES WILL BE OUTPUT IN F (INSTEAD OF E) FORMAT IN ORDER TO ALLOW ENERGIES TO BE WRITTEN WITH UP TO 9 DIGITS OF ACCURACY. IN PREVIOUS VERSIONS THIS WAS AN OUTPUT OPTION. HOWEVER USE OF THIS OPTION TO COMPARE THE RESULTS OF ENERGIES WRITTEN IN THE NORMAL ENDF/B CONVENTION OF 6 DIGITS TO THE 9 DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE TO USE THE 9 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA DUE TO TRUNCATION OF ENERGIES TO 6 DIGITS DURING OUTPUT.

CONTENTS OF OUTPUT

ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE LINEARIZED DATA CROSS SECTIONS, E.G. ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO INCLUDED.

DOCUMENTATION

THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED Linear
BY THE ADDITION OF 3 COMMENT LINES AT THE END OF EACH HOLLERITH Linear
SECTION IN THE FORM Linear
Linear
********** PROGRAM LINEAR (2015-1) ********** Linear
FOR ALL DATA GREATER THAN 1.00000-10 IN ABSOLUTE VALUE Linear
DATA LINEARIZED TO WITHIN AN ACCURACY OF 0.1 PER-CENT Linear
Linear
THE ORDER OF SIMILAR COMMENTS (FROM RECENT, SIGMA1 AND GROUPIE) Linear
REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON Linear
THE DATA BY THESE PROGRAMS. Linear
Linear
THESE COMMENT LINES ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS, Linear
I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT Linear
OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF Linear
EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451 Linear
IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF Linear
THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF Linear
MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO Linear
DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND Linear
AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT Linear
SHOULD BE USED TO CREATE A HOLLERITH SECTION. Linear
Linear
REACTION INDEX Linear
-------------- Linear
THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN Linear
SECTION MF=1, MT=451 OF EACH EVALUATION. Linear
Linear
THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451. Linear
THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT Linear
REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS Linear
NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING Linear
A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE Linear
A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM Linear
YOU MAY USE PROGRAM DICTIN TO CREATE A CORRECT REACTION INDEX. Linear
Linear
SECTION SIZE Linear
------------ Linear
SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT Linear
TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS Linear
SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS. Linear
Linear
FOR ANY LINEARIZED SECTION THAT CONTAINS 60000 OR FEWER POINTS Linear
THE ENTIRE OPERATION WILL BE PERFORMED IN CORE AND THE LINEARIZED Linear
DATA WILL BE OUTPUT DIRECTLY TO THE ENDF/B FORMAT. FOR ANY SECTION Linear
THAT CONTAINS MORE POINTS THE DATA WILL BE LINEARIZED A PAGE AT A Linear
TIME (1 PAGE = 60000 POINTS) AND OUTPUT TO SCRATCH. AFTER THE Linear
ENTIRE SECTION HAS BEEN LINEARIZED THE DATA WILL BE READ BACK FROM Linear
SCRATCH AND OUTPUT TO THE ENDF/B FORMAT. Linear
Linear
SELECTION OF DATA Linear
----------------- Linear
THE PROGRAM SELECTS DATA TO BE LINEARIZED BASED EITHER ON EITHER Linear
MAT (ENDF/B MAT NO.) OR ZA AS WELL AS MF AND MT NUMBERS. THIS Linear
PROGRAM ALLOWS UP TO 100 MAT/MF/MT OR ZA/MF/MT RANGES TO BE Linear
SPECIFIED BY INPUT PARAMETERS. THE PROGRAM WILL ASSUME THAT THE Linear
ENDF/B TAPE IS IN MAT ORDER, REGARDLESS OF THE CRITERIA USED Linear
TO RETRIEVE MATERIALS. IF RETRIEVAL IS BY MAT RANGE THE PROGRAM Linear
WILL TERMINATE WHEN A MAT IS FOUND THAT IS ABOVE ALL REQUESTED Linear
MAT RANGES. IF RETRIEVAL IS BY ZA RANGE THE PROGRAM WILL SEARCH Linear
THE ENTIRE ENDF/B TAPE. Linear
Linear
PROGRAM OPERATION Linear
----------------- Linear
EACH SECTION OF DATA IS CONSIDERED SEPARATELY. EACH SECTION OF Linear
ENDF/B DATA TO LINEARIZE IS REPRESENTED BY A TABLE OF ENERGY Linear
VS. CROSS SECTION AND ANY ONE OF FIVE ALLOWABLE INTERPOLATION LAWS Linear
BETWEEN ANY TWO TABULATED POINTS. THIS PROGRAM WILL REPLACE EACH Linear
SECTION OF DATA CROSS SECTIONS BY A NEW TABLE OF ENERGY VS. Linear
CROSS SECTION IN WHICH THE INTERPOLATION LAW IS ALWAYS LINEAR IN Linear
ENERGY AND CROSS SECTION BETWEEN ANY TWO TABULATED POINTS. Linear

DATA IS READ AND LINEARIZED A PAGE AT A TIME (ONE PAGE CONTAINS 60000 DATA POINTS). IF THE FINAL LINEARIZED SECTION CONTAINS TWO PAGES OR LESS, DATA POINTS IT WILL BE ENTIRELY CORE RESIDENT AFTER IT HAS BEEN LINEARIZED AND WILL BE WRITTEN DIRECTLY FROM CORE TO THE OUTPUT TAPE. IF THE LINEARIZED SECTION IS LARGER THAN TWO PAGES, AFTER EACH PAGE IS LINEARIZED IT WILL BE WRITTEN TO SCRATCH. AFTER THE ENTIRE SECTION HAS BEEN LINEARIZED IT WILL BE READ BACK FROM SCRATCH, TWO PAGES AT A TIME, AND WRITTEN TO THE OUTPUT TAPE.

KEEP EVALUATED DATA POINTS

SOMETIMES IT IS CONVENIENT TO KEEP ALL ENERGY POINTS WHICH WERE PRESENT IN THE ORIGINAL EVALUATION AND TO MERELY SUPPLEMENT THESE POINTS WITH ADDITIONAL ENERGY POINTS IN ORDER TO LINEARIZE THE CROSS SECTIONS. FOR EXAMPLE, IT IS OFTEN CONVENIENT TO KEEP THE THERMAL VALUE (AT 0.0253 EV) OR THE VALUE AT 14.1 MEV.

THE CURRENT VERSION OF THIS PROGRAM WILL ALLOW THE USER TO KEEP ALL ORIGINAL EVALUATED DATA POINTS BY SPECIFYING 1 IN COLUMNS 34-44 OF THE FIRST INPUT LINE. THIS WILL TURN OFF THE BACKWARD THINNING (SEE UCRL-50400, VOL. 17, PART A FOR EXPLANATION) AND RESULT IN ALL ORIGINAL ENERGY POINTS BEING KEPT. CAUTION SHOULD BE EXERCISED IN USING THIS OPTION SINCE IT CAN RESULT IN A CONSIDERABLE INCREASE IN THE NUMBER OF DATA POINTS OUTPUT BY THIS CODE.

FOR ALL USERS WHO ARE NOT INTERESTED IN THIS OPTIONS NO CHANGES ARE REQUIRED IN THE INPUT TO THIS PROGRAM, I. E. IF COLUMNS 34-44 ARE BLANK (AS FOR ALL PREVIOUS VERSIONS OF THIS CODE) THE PROGRAM WILL OPERATE EXACTLY AS IT DID BEFORE.

ALLOWABLE ERROR

ALLOWABLE ERROR MUST ALWAYS BE SPECIFIED IN THE INPUT TO THIS PROGRAM AS A FRACTION, NOT A PER-CENT. FOR EXAMPLE, INPUT THE ALLOWABLE FRACTIONAL ERROR 0.001 IN ORDER TO OBTAIN DATA THAT IS ACCURATE TO WITHIN 0.1 PER-CENT.

THE CONVERSION OF THE DATA FROM THE GENERAL INTERPOLATION FORM TO LINARLY INTERPOLABLE FORM CANNOT BE PERFORMED EXACTLY. HOWEVER, IT CAN BE PERFORMED TO VIRTUALLY ANY REQUIRED ACCURACY AND MOST IMPORTANTLY CAN BE PERFORMED TO A TOLERANCE THAT IS SMALL COMPARED TO THE UNCERTAINTY IN THE CROSS SECTIONS THEMSELVES. AS SUCH THE CONVERSION OF CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM CAN BE PERFORMED WITH ESSENTIALLY NO LOSE OF INFORMATION.

THE ALLOWABLE ERROR MAY BE ENERGY INDEPENDENT (CONSTANT) OR ENERGY DEPENDENT. THE ALLOWABLE ERROR IS DESCRIBED BY A TABULATED FUNCTION OF UP TO 20 (ENERGY,ERROR) PAIRS AND LINEAR INTERPOLATION BETWEEN TABULATED POINTS. IF ONLY ONE TABULATED POINT IS GIVEN THE ERROR WILL BE CONSIDERED CONSTANT OVER THE ENTIRE ENERGY RANGE. WITH THIS ENERGY DEPENDENT ERROR ONE MAY OPTIMIZE THE OUTPUT FOR ANY GIVEN APPLICATION BY USING A SMALL ERROR IN THE ENERGY RANGE OF INTEREST AND A LESS STRINGENT ERROR IN OTHER ENERGY RANGES.

DEFAULT ALLOWABLE ERROR

IN ORDER TO INSURE CONVERGENCE OF THE LINEARIZING ALGORITHM THE ALLOWABLE ERROR MUST BE POSITIVE. IF THE USER INPUTS AN ERROR THAT IS NOT POSITIVE IT WILL AUTOMATICALLY BE SET TO THE DEFAULT VALUE (CURRENTLY 0.001, CORRESPONDING TO 0.1 PER-CENT) AND INDICATED AS SUCH IN THE OUTPUT LISTING.

COULOMB PENETRABILITY (INTERPOLATION LAW = 6)

INTRODUCED FOR ENDF/B-VI. THIS IS DEFINED AS,

SIG(E) = C1*EXP(-C2/SQRT(E - T))

```
THIS PROGRAM ONLY CONSIDERS EXOTHERMIC REACTIONS - T = 0

SIG(E) = C1*EXP(-C2/SQRT(E))

WARNING...THIS INTERPOLATION LAW SHOULD ONLY BE USED FOR REACTIONS
          WHICH HAVE A POSITIVE Q-VALUE (EXOTHERMIC REACTIONS),
          SINCE HERE WE ONLY CONSIDER T = 0.0 IN THE FORMALISM.
          IN ALL OTHER CASES A WARNING MESSAGE WILL BE PRINTED.

INPUT FILES
-----------
UNIT  DESCRIPTION
----  -----------
   2  INPUT LINES (BCD - 80 CHARACTERS/RECORD)
  10  ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)

OUTPUT FILES
------------
UNIT  DESCRIPTION
----  -----------
   3  OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)
  11  FINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)

SCRATCH FILES
-------------
UNIT  DESCRIPTION
----  -----------
  12  SCRATCH FILE (BINARY - 180000 WORDS/RECORD

OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILEIO)
----------------------------------------------------
UNIT  FILE NAME
----  ----------
  2   LINEAR.INP
  3   LINEAR.LST
 10   ENDFB.IN
 11   ENDFB.OUT
 12   (SCRATCH)


INPUT PARAMETERS
----------------
FOR VERSIONS EARLIER THAN 90-1 THIS PROGRAM ONLY ALLOWED THE USER
TO SPECIFY BY INPUT PARAMETERS WHICH MATERIALS (MAT) TO PROCESS.
FOR EACH REQUESTED MATERIAL NEUTRON INTERACTION CROSS SECTIONS
(MF=3) WOULD BE LINEARIZED AND THE REMAINDER OF THE MATERIAL
WOULD BE COPIED.

FOR VERSIONS 90-1 AND LATER THIS PROGRAM WILL ALLOW THE USER TO
TO SPECIFY BY INPUT PARAMETERS EXACTLY WHAT SECTIONS OF DATA
TO PROCESS. FOR EACH SECTION OF DATA, SPECIFIED BY MAT, MF, MT
RANGES, SECTIONS OF MF=3, 23 AND 27 WILL BE LINEARIZED AND ALL
OTHER REQUESTED SECTIONS WILL BE COPIED. ALL SECTIONS WHICH ARE
NOT EXPLICITLY REQUESTED WILL BE SKIPPED AND WILL NOT APPEAR ON
ENDF/B FILE OUTPUT BY THIS PROGRAM.

WITH THIS NEW PROCEDURE YOU CAN MINIMIZE THE SIZE OF THE ENDF/B
FILE OUTPUT BY THIS PROGRAM, E.G., IF YOU ONLY WANT NEUTRON
CROSS SECTIONS FOR SUBSEQUENT PROCESSING YOU NEED ONLY REQUEST
ONLY MF=3 DATA.

HOWEVER, YOU MUST UNDERSTAND THAT ONLY THOSE SECTIONS WHICH YOU
EXPLICITLY REQUEST WILL APPEAR ON THE ENDF/B FILE OUTPUT BY
THIS PROGRAM. FOR EXAMPLE, IF YOU WISH TO DOCUMENT EXACTLY
HOW YOU LINEARIZED THE DATA BY INCLUDING COMMENTS IN MF=1, MT=451
THEN YOU MUST EXPLICITLY REQUEST THAT MF=1, MT=451 BE PROCESSED
FOR EACH MATERIAL THAT YOU REQUEST. SIMILAR IF YOU WANT THE
ENTIRE EVALUATION YOU MUST REQUEST ALL MF AND MT TO BE OUTPUT.

LINE  COLS.  DESCRIPTION
----  -----  -----------
```

1	1-11	SELECTION CRITERIA (0=MAT, 1=ZA)	Linear
	12-22	MONITOR MODE SELECTOR	Linear
		= 0 - NORMAL OPERATION	Linear
		= 1 - MONITOR PROGRESS OF LINEARIZING OF THE DATA.	Linear
		EACH TIME A PAGE OF DATA POINTS IS WRITTEN TO	Linear
		THE SCRATCH FILE PRINT OUT THE TOTAL NUMBER OF	Linear
		POINTS ON SCRATCH AND THE LOWER AND UPPER	Linear
		ENERGY LIMITS OF THE PAGE (THIS OPTION MAY BE	Linear
		USED IN ORDER TO MONITOR THE EXECUTION SPEED	Linear
		OF LONG RUNNING JOBS).	Linear
	23-33	MINIMUM CROSS SECTION OF INTEREST (BARNS).	Linear
		(IF 0.0 OR LESS IS INPUT THE PROGRAM WILL	Linear
		USE 1.0E-10). ENERGY INTERVALS WILL NOT BE	Linear
		SUB-DIVIDED IF THE ABSOLUTE VALUE OF THE CROSS	Linear
		SECTION WITHIN THE INTERVAL IS LESS THAN THIS VALUE.	Linear
		AN EXCEPTION TO THIS RULE IS NEAR THRESHOLDS ENERGY	Linear
		INTERVALS WILL BE SUB-DIVIDED UNTIL CONVERGENCE	Linear
		REGARDLESS OF THE MAGNITUDE OF THE CROSS SECTION.	Linear
	34-44	KEEP ORIGINAL EVALUATED DATA POINTS.	Linear
		= 0 - NO.	Linear
		= 1 - YES - ADDITIONAL POINTS MAY BE ADDED IN ORDER	Linear
		TO LINEARIZE DATA, BUT ALL ORIGINAL	Linear
		DATA POINTS WILL BE INCLUDED IN THE	Linear
		RESULTS.	Linear
2	1-72	ENDF/B INPUT DATA FILENAME	Linear
		(STANDARD OPTION = ENDFB.IN)	Linear
3	1-72	ENDF/B OUTPUT DATA FILENAME	Linear
		(STANDARD OPTION = ENDFB.OUT)	Linear
4-N	1- 6	LOWER MAT OR ZA LIMIT	Linear
	7- 8	LOWER MF LIMIT	Linear
	9-11	LOWER MT LIMIT	Linear
	12-17	UPPER MAT OR ZA LIMIT	Linear
	18-19	UPPER MF LIMIT	Linear
	20-22	UPPER MT LIMIT	Linear
		UP TO 100 RANGES MAY BE SPECIFIED, ONLY ONE RANGE	Linear
		PER LINE. THE LIST OF RANGES IS TERMINATED BY A	Linear
		BLANK LINE. IF THE UPPER MAT LIMIT OF ANY REQUEST	Linear
		IS LESS THAN THE LOW LIMIT IT WILL BE SET EQUAL TO	Linear
		THE LOWER LIMIT. IF THE UPPER LIMIT IS STILL ZERO	Linear
		IT WILL BE SET EQUAL TO 999999. IF THE UPPER MF OR	Linear
		MT LIMIT IS ZERO IT WILL BE SET TO 99 OR 999	Linear
		RESPECTIVELY.	Linear
VARY	1-11	ENERGY FOR ERROR LAW	Linear
	12-22	ALLOWABLE FRACTIONAL ERROR FOR ERROR LAW.	Linear
		THE ACCEPTABLE LINEARIZING ERROR MAY BE SPECIFIED TO	Linear
		BE EITHER ENERGY INDEPENDENT (DEFINED BY A SINGLE	Linear
		ERROR), OR ENERGY DEPENDENT (DEFINED BY UP TO 20	Linear
		ENERGY, ERROR PAIRS). FOR THE ENERGY DEPENDENT CASE	Linear
		LINEAR INTERPOLATION WILL BE USED TO DEFINE THE ERROR	Linear
		AT ENERGIES BETWEEN THOSE AT WHICH IT IS TABULATED.	Linear
		IN ALL CASES THE ERROR LAW IS TERMINATED BY A BLANK	Linear
		LINE. IF ONLY ONE ENERGY, ERROR PAIR IS GIVEN THE	Linear
		THE LAW WILL BE CONSIDERED TO BE ENERGY INDEPENDENT.	Linear
		IF MORE THAN ONE PAIR IS GIVEN IT WILL BE CONSIDERED	Linear
		TO BE ENERGY DEPENDENT (NOTE, ENERGY INDEPENDENT	Linear
		FORM WILL RUN FASTER THAN THE EQUIVALENT ENERGY	Linear
		DEPENDENT FORM). FOR AN ENERGY DEPENDENT ERROR LAW	Linear
		ALL ENERGIES MUST BE ASCENDING ENERGY ORDER. FOR	Linear
		CONVERGENCE OF THE LINEARIZING ALGORITHM ALL ERRORS	Linear
		MUST BE POSITIVE. IF AN ALLOWABLE ERROR IS NOT	Linear
		POSITIVE IT WILL BE SET EQUAL TO THE STANDARD OPTION	Linear
		(CURRENTLY 0.001, CORRESPONDING TO 0.1 PER-CENT).	Linear
		IF THE FIRST ERROR LINE IS BLANK IT WILL TERMINATE	Linear
		THE ERROR LAW AND THE ERROR WILL BE TREATED AS	Linear
		ENERGY INDEPENDENT, EQUAL TO THE STANDARD OPTION	Linear
		(CURRENTLY 0.1 PER-CENT). (SEE EXAMPLE INPUT 4).	Linear

Linear

EXAMPLE INPUT NO. 1 Linear

Linear

RETRIEVE DATA BY ZA IN ORDER TO FIND ALL URANIUM ISOTOPES AND Linear
THORIUM 232. RETRIEVE ALL NEUTRON INTERACTION CROSS SECTIONS Linear

```
    (MF=3). ALL ENERGY INTERVALS IN WHICH THE CROSS SECTION IS         Linear
    AT LEAST 1 MICRO-BARN (1.0E-06 BARNS) WILL BE SUBDIVIDED.          Linear
    BACKWARD THINNING WILL BE PERFORMED. FROM 0 TO 100 EV LINEARIZE    Linear
    TO WITHIN 0.1 PER-CENT ACCURACY. FROM 100 EV TO 1 KEV VARY         Linear
    ACCURACY BETWEEN 0.1 AND 1.0 PER-CENT. ABOVE 1 KEV USE 1           Linear
    PER-CENT ACCURACY.                                                 Linear
                                                                       Linear
    EXPLICITLY SPECIFY THE STANDARD FILENAMES.                         Linear
                                                                       Linear
    IN THIS CASE THE FOLLOWING 11 INPUT LINES ARE REQUIRED             Linear
                                                                       Linear
         1          0 1.00000- 6          0                          Linear
ENDFB.IN                                                               Linear
ENDFB.OUT                                                              Linear
92000 3  0 92999 3999                                                  Linear
90232 3  0     0 3  0    (UPPER LIMIT AUTOMATICALLY SET TO 90232 3999) Linear
                         (END OF REQUEST LIST)                         Linear
0.00000+ 0 1.00000-03                                                  Linear
1.00000+ 2 1.00000-03                                                  Linear
1.00000+ 3 1.00000-02                                                  Linear
1.00000+ 9 1.00000-02                                                  Linear
                         (END OF ERROR LAW)                            Linear
                                                                       Linear
    EXAMPLE INPUT NO. 2                                                Linear
    ------------------                                                 Linear
    SAME AS THE ABOVE CASE, EXCEPT LINEARIZE ALL DATA TO WITHIN THE    Linear
    STANDARD ACCURACY (CURRENTLY 0.1 PER-CENT). IN ORDER TO USE THE    Linear
    STANDARD ACCURACY YOU NEED NOT SPECIFY ANY ERROR LAW AT ALL. IN    Linear
    THIS CASE INCLUDE THE HOLLERITH SECTION, MF=1, MT=451, FOR EACH    Linear
    MATERIAL.                                                          Linear
                                                                       Linear
    LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL     Linear
    THEN USE STANDARD FILENAMES.                                       Linear
                                                                       Linear
    IN THIS CASE THE FOLLOWING 9 INPUT LINES ARE REQUIRED              Linear
                                                                       Linear
         1          0 1.00000- 6          0                          Linear
                         (USE DEFAULT FILENAME = ENDFB.IN)             Linear
                         (USE DEFAULT FILENAME = ENDFB.OUT)            Linear
92000 1451 92999 1451                                                  Linear
92000 3  0 92999 3999                                                  Linear
90232 1451     0 1451                                                  Linear
90232 3  0     0 3  0    (UPPER LIMIT AUTOMATICALLY SET TO 90232 3999) Linear
                         (END OF REQUEST LIST)                         Linear
                         (0.1 PER-CENT ERROR, END OF ERROR LAW)        Linear
                                                                       Linear
    EXAMPLE INPUT NO. 3                                                Linear
    ------------------                                                 Linear
    LINEARIZE ALL MATERIALS ON AN ENDF/B TAPE TO WITHIN AN ACCURACY    Linear
    OF 0.5 PER-CENT (0.005 AS A FRACTION). IN THIS CASE YOU NEED NOT   Linear
    SPECIFY THE MAT, MF, MT RANGES.                                    Linear
                                                                       Linear
    READ THE ENDF/B DATA FROM \ENDFB6\ZA092238 AND WRITE THE ENDF/B    Linear
    DATA TO \ENDFB6\LINEAR\ZA092238.                                   Linear
                                                                       Linear
    IN THIS CASE THE FOLLOWING 6 INPUT LINES ARE REQUIRED              Linear
                                                                       Linear
                                          (MAT, 1.0E-10 BARNS, THIN)   Linear
\ENDFB6\ZA092238                                                       Linear
\ENDFB6\LINEAR\ZA092238                                                Linear
                         (RETRIEVE ALL DATA, END REQUEST LIST)         Linear
           5.00000-03                                                  Linear
                         (END OF ERROR LAW)                            Linear
                                                                       Linear
    NOTE THAT IN THIS CASE IF THE INPUT HAD SPECIFIED AN EQUIVALENT    Linear
    ENERGY DEPENDENT ERROR LAW BY GIVING A NUMBER OF ENERGY POINTS     Linear
    AT EACH OF WHICH THE ERROR IS 0.5 PER-CENT THE PROGRAM WOULD TAKE  Linear
    LONGER TO RUN (I.E., ONLY USE AN ENERGY DEPENDENT ERROR LAW WHEN   Linear
    IT IS NECESSARY).                                                  Linear
                                                                       Linear
    EXAMPLE INPUT NO. 4                                                Linear
```

```
     -------------------                                                Linear
     IN ORDER TO LINEARIZE ALL MATERIALS ON AN ENDF/B TAPE TO THE       Linear
     STANDARD OPTION OF 0.1 PER-CENT IT IS ADEQUATE TO INPUT A SET      Linear
     OF COMPLETELY BLANK LINES WHICH WILL AUTOMATICALLY INVOKE ALL      Linear
     OF THE STANDARD OPTIONS.                                           Linear
                                                                        Linear
     LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL     Linear
     THEN USE STANDARD FILENAMES.                                       Linear
                                                                        Linear
     IN THIS CASE THE FOLLOWING THREE INPUT LINES ARE REQUIRED          Linear
                                                                        Linear
                                          (MAT, 1.0E-10 BARNS, THIN)    Linear
                          (USE DEFAULT FILENAME = ENDFB.IN)             Linear
                          (USE DEFAULT FILENAME = ENDFB.OUT)            Linear
                          (RETRIEVE ALL DATA, END REQUEST LIST)         Linear
                          (0.1 PER-CENT ERROR, END OF ERROR LAW)        Linear
                                                                        Linear
=========================================================================== Linear
```